Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						4	3	3	5	/	2	H	Signature	

Paper Reference(s)

4335/2H

Examiner's use only

Team Leader's use only

London Examinations IGCSE

Chemistry

Paper 2H

Higher Tier

Tuesday 10 November 2009 – Afternoon

Time: 2 hours

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname and initial(s) and your signature.
The paper reference is shown at the top of this page. Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Show all stages in any calculations and state the units. Calculators may be used.
Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (~~☒~~) and then mark your new answer with a cross (☒).

Information for Candidates

The total mark for this paper is 120. The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 11 questions in this question paper.
There are 24 pages in this question paper. Any blank pages are indicated.
A Periodic Table is given on page 2.

Advice to Candidates

Write your answers neatly and in good English.

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THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
1	1 H Hydrogen 1																	4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass

Symbol

Name

Atomic number

Leave blank

SECTION A

1. (a) Complete the table of information about the three types of particle found in an atom.

Name of particle	Relative mass	Relative charge
electron		–1
neutron	1	
proton		

(4)

(b) An atom of chlorine can be represented by the symbol

$$^{35}_{17}\mathrm{Cl}$$

(i) Explain the meaning of the term **mass number**. State the mass number of this chlorine atom.

.....

.....

.....

.....

(2)

(ii) How many neutrons are in this atom of chlorine?

.....

(1)

(c) There are two types of boron atoms. Some contain 5 protons and 5 neutrons while others contain 6 neutrons.

(i) How many protons do the second type of boron atoms contain?

.....

(1)

(ii) What name is given to atoms of the same element with different numbers of neutrons?

.....

(1) **Q1**

(Total 9 marks)

Leave blank

2. Propanone and water are both covalently bonded compounds. The table shows their boiling points.

Compound	Boiling point (°C)
propanone	56
water	100

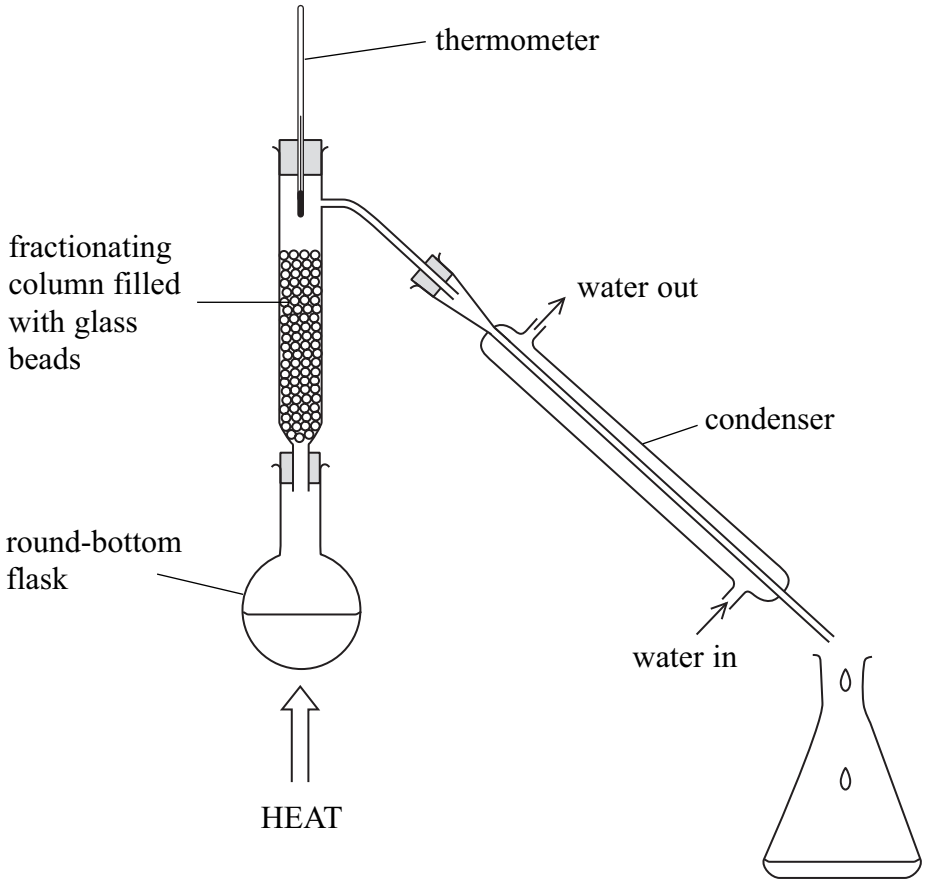
(a) Some anhydrous copper(II) sulphate was added to a mixture of propanone and water. What colour change would be seen?

Colour at start .....

Colour at end .....

(2)

(b) Propanone can be obtained from a mixture of propanone and water using the apparatus shown.



(i) Name the method of separation carried out using this apparatus.

.....

(2)

Leave blank

(ii) Why can propanone and water be separated by this method?

.....

(1)

(iii) Outline how a sample of pure propanone can be obtained from the mixture.

.....

.....

.....

.....

.....

(3)

(c) Propanone and water both have simple molecular structures. They have low boiling points. Place a cross (☒) in **one** box from **each** column of statements to explain why they have low boiling points.

the covalent bonds between their atoms are strong	☒		
the covalent bonds between their atoms are weak	☒		
		AND	
the attractive forces between their molecules are strong	☒		
the attractive forces between their molecules are weak	☒		

		these require a lot of energy to be overcome	☒
		these require little energy to be overcome	☒
		these get weaker as the temperature increases	☒

(2)

(Total 10 marks)

Q2

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3. A sodium atom has the electronic configuration 2.8.1
An oxygen atom has the electronic configuration 2.6

(a) State, in terms of electrons, what happens to a sodium atom when it reacts with oxygen. Give the symbol of the sodium species formed.

.....

.....

.....

(2)

(b) State, in terms of electrons, what happens to an oxygen atom when it reacts with sodium. Give the symbol of the species formed from the oxygen atom.

.....

.....

.....

(2)

(c) State the name and formula of the compound formed when sodium reacts with oxygen.

Name .....

Formula .....

.....

(2)

Q3

(Total 6 marks)

Leave blank

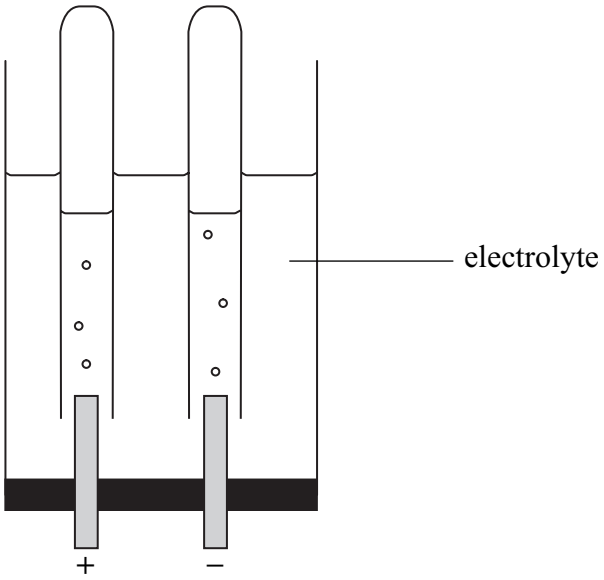
4. This question is about chlorine and other elements in Group 7 of the Periodic Table.

(a) Complete the table to show the colours and states of some elements in Group 7.

Name of element	Colour	State at room temperature
chlorine	green	gas
bromine	brown	
iodine		solid

(2)

(b) The diagram shows the electrolysis of an aqueous solution of a compound.
The electrolysis produces chlorine and another gas.



(i) Add a label to the diagram to show the chlorine gas.

(1)

(ii) Identify the other gas produced during the electrolysis.

.....

(1)

(iii) What is the electrolyte used in the industrial production of chlorine?

.....

(1)

Leave blank

(c) When chlorine gas is bubbled into colourless sodium bromide solution a reaction takes place. The solution becomes brown.

(i) Write a word equation for the reaction which takes place.

.....

(2)

(ii) What name is given to this type of reaction?

.....

(1)

(iii) What does this reaction indicate about the reactivity of chlorine compared to bromine?

.....

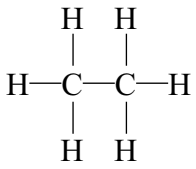
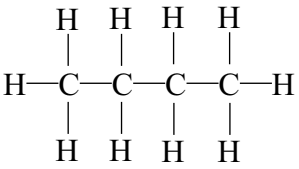
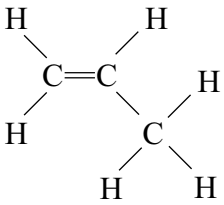
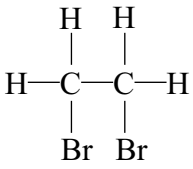
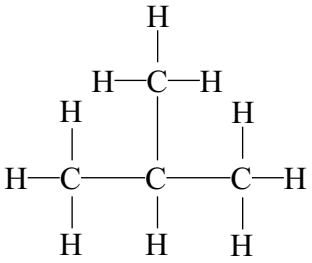
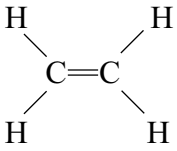
(1)

Q4

(Total 9 marks)

Leave blank

5. The table shows the structures of some organic compounds.

 **A**	 **B**
 **C**	 **D**
 **E**	 **F**

(a) Explain why compound **C** is not a saturated hydrocarbon.

.....

.....

(1)

(b) Explain why compound **D** is not a hydrocarbon.

.....

.....

(1)

(c) Give the letters of two compounds that are isomers of each other.

.....

(1)

Leave blank

(d) Give the letters of two compounds that are members of the same homologous series but have different molecular formulae.

.....

(1)

(e) Name and give the general formula of the homologous series to which compound **E** belongs.

Name of homologous series .....

General formula .....

(2)

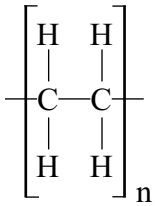
(f) What colour change is seen when bromine water is added to compound **F**?

.....

.....

(2)

(g) A polymer has the structure:



(i) Give the letter of the monomer which is used to make this polymer.

.....

(1)

(ii) Give the name of the polymer.

.....

(1)

(iii) What type of polymer is this?

.....

(1)

Q5

(Total 11 marks)

TOTAL FOR SECTION A: 45 MARKS

Leave blank

SECTION B

6. Lithium and sodium are metals in Group 1 of the Periodic Table. They react in a similar way with water, producing hydrogen gas and an alkaline solution.

(a) A student added a piece of lithium to a trough of water. A piece of platinum wire is dipped into the solution formed and then held in a hot Bunsen flame.

(i) What colour does the flame become?

.....

(1)

(ii) What is the formula of the ion responsible for this colour?

.....

(1)

(b) State the colour of methyl orange in the alkaline solution formed in (a) and give the formula of the ion which causes the solution to be alkaline.

Colour of methyl orange .....

Formula of ion .....

(2)

(c) A piece of sodium is added to another trough of water.

(i) Give two observations, other than the sodium floating, that you could make during the reaction.

1 .....

2 .....

(2)

(ii) Write a chemical equation for the reaction.

.....

.....

(2)

Leave blank

(d) Rubidium is another Group 1 metal. A piece of rubidium is added to a different trough of water.

(i) Predict one observation that would be different using rubidium instead of sodium.

.....

.....

(1)

(ii) Predict a possible pH value for the solution formed in the reaction between rubidium and water.

.....

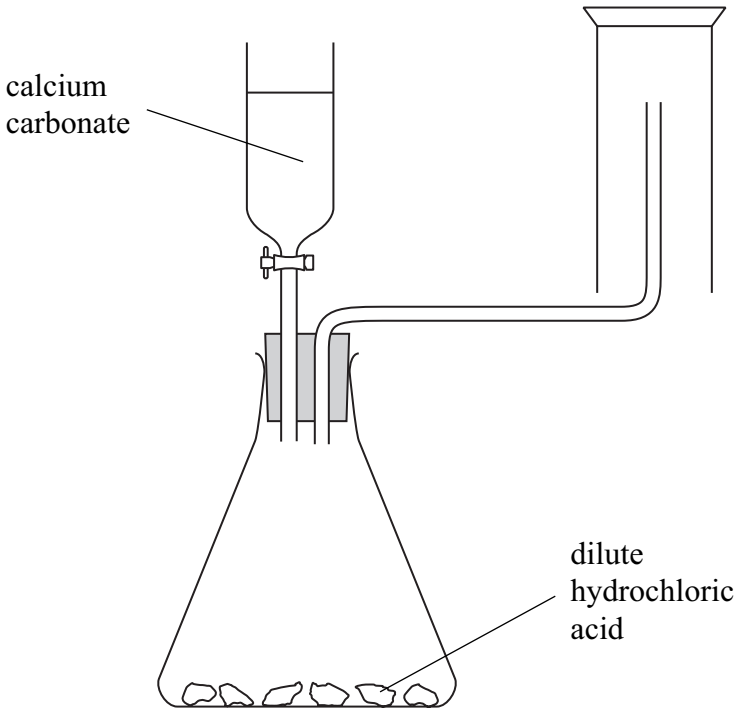
(1)

Q6

(Total 10 marks)

Leave blank

7. (a) A student was asked to draw a diagram to show apparatus he would use to prepare carbon dioxide gas in the laboratory. This is the diagram he drew.



(i) State how the diagram is labelled incorrectly.

.....

.....

(1)

(ii) Why is the method of collection of carbon dioxide unsuitable?
How could the carbon dioxide be collected?

.....

.....

.....

(2)

(iii) Write a chemical equation, including state symbols, for the reaction that occurs in the conical flask.

.....

.....

(3)

Leave blank

(b) A teacher prepares a gas jar of oxygen.
She then lights a piece of magnesium ribbon and places it in the gas jar.
A vigorous reaction occurs.

Give two observations she could make during the reaction between magnesium and oxygen.

1 .....

2 .....

(2)

(c) The ionic compound formed during the reaction in the gas jar is magnesium oxide.
The melting point of magnesium oxide is 2857 °C.
The melting point of sodium chloride is 801 °C.

(i) Explain why both magnesium oxide and sodium chloride have high melting points.

.....

.....

.....

.....

(2)

(ii) Explain why the melting point of magnesium oxide is much higher than that of sodium chloride.

.....

.....

.....

.....

(2)

Q7

(Total 12 marks)

Leave blank

8. Iron is extracted from iron ore in a blast furnace using three raw materials, **J**, **K** and **L**.

J is a black solid, **K** is a white solid composed mostly of calcium carbonate, and **L** is a colourless mixture of gases.

(a) Give the names of these raw materials.

J .....

K .....

L .....

(3)

(b) The chemical equations for three reactions that occur in the blast furnace are:

I $C + O_2 \rightarrow CO_2$

II $C + CO_2 \rightarrow 2CO$

III $CaCO_3 \rightarrow CaO + CO_2$

(i) Explain why reaction **I** is important in the blast furnace.

.....

(1)

(ii) State the function of the product of reaction **II**.

.....

(1)

(iii) The function of the CaO formed in reaction **III** is to remove impurities in the iron ore. Write a chemical equation to show the reaction that occurs.

.....

(2)

(c) Two molten substances, **M** and iron, collect at the bottom of the blast furnace. Give the name of **M** and suggest why it floats on top of the molten iron.

.....

.....

.....

(2)

Leave blank

(d) Iron has many uses.

Suggest one property of iron, different in each case, that makes it suitable for:

making railway lines .....

.....

using in the Haber process .....

.....

(2)

(e) One problem with using iron to make objects is rusting.
Galvanising is a method of preventing rusting that involves coating iron with zinc.

(i) Give the chemical name of rust.

.....

(1)

(ii) Explain how zinc is able to prevent iron from rusting even when the coating is scratched.

.....

.....

.....

.....

(2)

Q8

(Total 14 marks)

Leave blank

9. Iron and copper are both examples of transition metals.

(a) One property of transition metals is variable valency.
This can be shown by the formation of two different chlorides of iron.

(i) When iron is heated in hydrogen chloride gas, iron(II) chloride is formed. Write a chemical equation for this reaction.

.....

.....

(2)

(ii) The equation for the formation of iron(III) chloride is:

$$2Fe(s) + 3Cl_2(g) \rightarrow 2FeCl_3(s)$$

Explain, in terms of electrons, why this reaction involves both oxidation and reduction.

.....

.....

.....

(2)

(b) Separate solutions of the chlorides formed in part (a) can be identified using sodium hydroxide solution.
Describe the observation you would make when sodium hydroxide solution is added to:

iron(II) chloride solution .....

iron(III) chloride solution .....

(2)

Leave blank

(c) The following sequence shows two reactions of copper(II) compounds.

$$CuCl_2(aq) \xrightarrow{NaOH(aq)} Cu(OH)_2(s) \xrightarrow{NH_3(aq)} [Cu(H_2O)_2(NH_3)_4]^{2+}(aq)$$

P **Q** **R**

(i) State the colour of **Q**.

.....

(1)

(ii) State two observations you would make when **Q** is converted into **R**.

1 .....

2 .....

(2)

(iii) What type of cation is **R**?

.....

(1)

(iv) Describe a test, and its result, to show that solution **P** contains chloride ions.

Test .....

.....

Result .....

(3)

Q9

(Total 13 marks)

Leave blank

10. A student wanted to find the concentration of a solution of nitric acid.

She placed a 25.0 cm^3 sample of the nitric acid solution in a conical flask and titrated it with 0.200 mol dm^{-3} sodium hydroxide solution, using phenolphthalein as an indicator. The phenolphthalein changed colour after she added a total of 21.05 cm^3 of the sodium hydroxide solution.

The equation for the reaction is:

$$NaOH(aq) + HNO_3(aq) \rightarrow NaNO_3(aq) + H_2O(l)$$

(a) State the colour change of the phenolphthalein.

.....

.....

(2)

(b) (i) Calculate the amount, in moles, of sodium hydroxide used in the titration.

(2)

(ii) Calculate the concentration, in mol dm^{-3}, of the nitric acid.

(2)

Leave blank

(c) (i) Calculate the relative formula mass of sodium nitrate.

(1)

(ii) Calculate the mass of sodium nitrate formed in the titration.

(2)

(d) A solution of sodium nitrate was formed by neutralising some dilute nitric acid with aqueous sodium hydroxide.
Outline how you could obtain a dry sample of sodium nitrate crystals from the solution formed.

.....

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(3)

Q10

(Total 12 marks)

Leave blank

11. The sequence shows the steps that can be used to obtain ethanol from crude oil.

$$\text{crude oil} \xrightarrow{\text{Step 1}} \text{diesel} \xrightarrow{\text{Step 2}} \text{ethene} \xrightarrow{\text{Step 3}} \text{ethanol}$$

(a) Step 1 is fractional distillation, which takes place in a fractionating column. Crude oil vapour is pumped in just above the bottom of the column.

(i) Describe how the fractions are separated in the fractionating column.

.....

.....

.....

.....

(2)

(ii) Explain why the hydrocarbons in the fuel oil fraction are obtained from the column below the hydrocarbons in the diesel fraction.

.....

.....

.....

.....

(2)

(iii) One of the hydrocarbons in the diesel fraction has the formula $C_{16}H_{34}$. Suggest the formula of a hydrocarbon found in the gasoline fraction.

.....

(1)

(iv) Name the fraction that is more viscous than fuel oil.

.....

(1)

Leave blank

(b) Step 2 is cracking, which is carried out by heating the diesel fraction with a catalyst.

(i) During cracking, one molecule of $C_{16}H_{34}$ is converted into one molecule of ethene and one molecule of hydrocarbon **X**.
State the formula of **X**.

.....

.....

(1)

(ii) Describe, in terms of the bonds broken and formed, what happens during cracking.

.....

.....

(2)

(c) Step 3 is hydration, which is carried out by heating ethene and steam at a temperature of about 300 °C and a pressure of about 65 atm.

(i) Identify one other condition used in Step 3.

.....

(1)

(ii) Write a chemical equation for the reaction occurring in Step 3.

.....

.....

(2)

QUESTION 11 CONTINUES OVERLEAF

Leave blank

(d) The ethanol formed in Step 3 can be converted into compound **Y** by heating it with acidified potassium dichromate(VI) solution.

(i) Identify the type of reaction occurring during this conversion.

.....

(1)

(ii) Name compound **Y**.

.....

(1)

Q11

(Total 14 marks)

TOTAL FOR SECTION B: 75 MARKS

TOTAL FOR PAPER: 120 MARKS

END